Complex Permittivity and Refractive Index for Metals

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The following figures plot the frequency dependent complex permittivity $\epsilon = \epsilon' + i\epsilon''$ and refractive index $n = n' + in''$ for silver, aluminum, gold, copper, chromium, nickel, tungsten, titanium, beryllium, palladium, and platinum using either the Drude (Equation 3), Lorentz-Drude (Equation 4), or Brendel-Bormann (Equation 5) models in the range 200 nm to 2000 nm. The material parameters and mathematical formalism detailed in [1]. These tables are generated programmatically. Three different models for the complex permittivity are tabulated. The first two are the Drude and Lorentz-Drude (LD) models.

\[ \epsilon_D = \epsilon_D \]
\[ \epsilon_{LD} = \epsilon_D + \epsilon_L \]

where $\epsilon_D$ is contribution from the Drude model, representing free electron effects

\[ \epsilon_D = 1 - \frac{\sqrt{\omega_0^2 \omega'^2}}{\omega (\omega - i\Gamma_0)} \]  

and $\epsilon_L$ is the Lorentz contribution, representing the bound electron effects

\[ \epsilon_L = \sum_{j=0}^{k} \frac{f_j \omega_p^2}{\omega_j^2 - \omega^2 + i\omega \Gamma_j} \]

The third is the Brendel-Bormann model which is based instead on an infinite superposition of oscillators

\[ \epsilon_{BB} = \frac{1}{\sqrt{2\pi} \sigma_n} \int_{-\infty}^{\infty} \exp\left( -\frac{(x - \omega_n^{'2})}{2\sigma_n^2} \right) \frac{f_j \omega_p^2}{(x^2 - \omega^2) + i\omega \Gamma_n} \, dx \]
Figure 1: Material parameters for Ag based on the Drude, Lorentz-Drude, and Brendel-Bormann models.
Figure 2: Material parameters for Al based on the Drude, Lorentz-Drude, and Brendel-Bormann models.
Figure 3: Material parameters for Au based on the Drude, Lorentz-Drude, and Brendel-Bormann models.
Figure 4: Material parameters for Cu based on the Drude, Lorentz-Drude, and Brendel-Bormann models.
0.5 Cr

Figure 5: Material parameters for Cr based on the Drude, Lorentz-Drude, and Brendel-Bormann models.
Figure 6: Material parameters for Ni based on the Drude, Lorentz-Drude, and Brendel-Bormann models.
Figure 7: Material parameters for W based on the Drude, Lorentz-Drude, and Brendel-Bormann models.
Figure 8: Material parameters for Ti based on the Drude, Lorentz-Drude, and Brendel-Bormann models.
Figure 9: Material parameters for Be based on the Drude, Lorentz-Drude, and Brendel-Bormann models.
Figure 10: Material parameters for Pd based on the Drude, Lorentz-Drude, and Brendel-Bormann models.
Figure 11: Material parameters for Pt based on the Drude, Lorentz-Drude, and Brendel-Bormann models.
References